

# **Future Concepts For Integrating The Space Launch System And The Multi-Purpose Crew Vehicle Into A Reusable Space Transportation Infrastructure**

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A space transportation infrastructure is described that utilizes the Space Launch System (SLS), the Multi-Purpose Crew Vehicle (MPCV), the International Space Station (ISS), and propellant depot servicing platforms to support all foreseeable missions in the Earth-Moon vicinity and deep space out to Mars. The infrastructure utilizes current expendable launch vehicle (ELV) systems such as the Delta IV Heavy, Atlas V, and Falcon 9, for commercial crew, cargo, and propellant launches to a Low-Earth-Orbit (LEO) Depot and/or the ISS. The SLS provides all payload and propellant launches to the Earth-Moon Lagrange Point 1 (EML1) Depot to support new reusable in-space transportation vehicles. The ISS or follow-on LEO Depot supports missions to Geosynchronous Earth Orbit (GEO) for satellite servicing and to Earth-Moon L1 for EML1 Depot missions. The EML1 Depot supports Lunar, Earth-Sun L2 (ESL2), Asteroid, and Mars missions. New vehicle design concepts are presented that can be launched utilizing the SLS and current ELV systems. These new reusable vehicle concepts include a Crew Transfer Vehicle (CTV) derived from the MPCV and a reusable Cryogenic Propulsion Stage (CPS) for crew transportation between the LEO Depot, EML1 Depot and missions beyond the Earth-Moon vicinity; a new reusable Lunar Lander for crew transportation between the EML1 Depot and the lunar surface; and a new reusable Deep Space Habitat (DSH) with a CTV to support crew missions from the EML1 Depot to ESL2, Asteroids, and a Mars Orbital Depot. The LEO Depot, EML1 Depot, and Mars Orbital Depot are based on International Space Station (ISS) heritage hardware. Data provided includes the number of launches required for each mission utilizing SLS and current ELV systems (Delta IV Heavy or equivalent) and the approximate vehicle masses and propellant requirements. Also included is a discussion on affordability with ideas on technologies that could reduce the number of launches required and thoughts on how this infrastructure might be implemented incrementally over the next few decades. The potential benefits of this infrastructure include competitive bidding for ELV flights and propellant services, development of new reusable in-space vehicles, and development of a robust multiuse infrastructure that can support many government and commercial missions simultaneously.

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